

**DIAGNOSTIC STUDY AND SOME ECOLOGICAL ASPECTS OF
STABLE FLY *STOMOXYS CALCITRANS* L. 1758
(DIPTERA:MUSCIDAE) IN BASRAH PROVINCE, IRAQ.**

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ABSTRACT

This study was conducted during June 2016 to May 2017, to determine the morphological characteristics of stable fly *Stomoxys calcitrans* L. ,and studying some ecological aspects. These studies of stable flies are being conducted for the first time in Iraq.The morphological diagnosis of *Stomoxys calcitrans*: Frontal vitta with black pollinose, yellow around ocellar triangle, parafrontalia golden, parafacialia grayish black. Thorax gray to yellowish pollinose, Pleura yellow; sternites dark brown to black, Legs black, Wing tinged smoky-brown. Abdomen gray to yellowish; dorsum with four brownish pollinose spots, at least 3 abdominal segments with a single median spot basally and pair of spots at apex of each segment. Female identical to male in color and structure except for wider frontal vitta, frontal triangle with golden pollinosity extending almost to frontal ridge, setae on head somewhat stouter than in male, Interocular space wide in females, narrower in males by about half the distance of separation in females.

A total of 470 flies were collected in this study. The results showed, some variations of monthly abundance were determined during the study period, four different climatic seasons. In general, stable flies were found to be more abundant in the moderate climates period of the year. April was the highest abundance with 18.7%, while, no presence recorded in January and December. Some observations showed that stable flies were found in the field in different periods of the day, beginning from 06:00 to 18:00 hr.,but these are periods that are considered the peak of its presence of other seasons during the year. Both sexes of *S. calcitrans* showed a same peak of activity in the day

nearly. The field observations showed that *Stomoxys calcitrans* adults attack many economic and domesticated animals in Basrah province. Cattle are the most, followed by buffaloes, dogs, horses, cats, camels, donkeys than sheep, goats and rabbits.

INTRODUCTION

Stable flies are classified into the order Diptera, family Muscidae, subfamily Muscinae, tribe Stomoxysini, genus *Stomoxys*, with 18 species have been described (1). They have attained a worldwide distribution, are more common in temperate and tropics regions compared with cooler climates(2). The adult flies feed on the blood of both humans and animals, a major irritant pest of both livestock and worldwide(3). The high activity of stable flies causes a nuisance to humans, this insect has been called the biting house fly(4). Stable flies and house flies are similar in size, color and general appearance, a distinguish feature that separates the two kinds is the distinct stiletto-like proboscis of the stable flies, which is used to pierce the skin and draw blood(5). The house fly cannot bite since it has sponging mouthparts.

Both male and female of stable flies depend on blood, they needed blood meals for survival, sperm growth and egg production(6), The adults suck nectar of flowers and liquid of fruits(7), plant meal may provide them with immediate source of energy for flying activity, However meal without blood, sperms and eggs not growth(4). The female, when depositing eggs, will often crawl into loose material. Each female fly may lay 500–600 eggs in separate batches. Eggs are small, white, and sausage-shaped(8). Eggs hatch in 2–5 days into larvae, which feed and mature in 14–26 days(9). Larvae are typical maggots and transform to small, reddish-brown, capsule-like pupae from which the adult flies emerge. The average life cycle is 28 days, ranging from 22–58 days depending on the weather(10).

Stable flies are important medical and veterinary pests of livestock, they can act as vectors and potential vectors of many animal pathogens and parasites(6). They can attack many domestic mammals, cows, sheep, horses, goats, dogs, camels and many wild mammals(4). They have been implicated as a mechanical vector for several pathogens,

such as viruses (Equine Infectious anemia, African Swine Fever and Bovine Leukosis)(11), bacteria (*Bacillus anthracis* and *Enterobacter* sp.), Recktesia (*Anaplasma* sp. , *Theileria* sp. and *Babesia* sp.)(6), Protozoa (*Trypanosoma evansi*, *T. brucei* and *T. vivax*), Helminthes (*Besnotia* sp. and some microfilaria). *Stomoxys* sp. are also involved in biological transmission of the nematode *Habronema magus* and *H. microstoma* , a stomach worms of equines(12).

The economic important of stable flies, especially on domestic mammals, results from transmission of pathogens and the biting activity. Biting of flies causes stress to cattle resulting in economic losses through weight gain(13), The important sources of livestock losses When cattle are subjected to mass attacks by the flies, physical injury, lower milk production and loss of pasturing time occurred leading to heat stress and weight loss(14), and they may stop feeding and crowd in bunches which leads to heat stress and weight loss. (15) also reported a 7% reduction in weight gain per stable fly on grazing yearling cattle.

Due to the absence of any taxonomic or ecological studies about stable flies in Iraq, this study was conducted to identify *Stomoxys calcitrans* based on morphological characteristics. and to determine species diversity, relative population abundance, diurnal activity and hosts of stable flies in Basrah Province.

MATERIALS AND METHODS

The present study has been conducted in Basrah Province, South of Iraq, including ten locations: Fao, Abu Al-Khaseeb, Shat Al-Arab, Qarmat Ali, Dair, Qurnah, Mdainah, Zubair and Slayen Marsh. Adult flies were collected bimonthly During June 2016 to May 2017 using canopy traps and malaise traps, sometimes with direct collection by nets. Samples collected by the traps were fixed on thick paper and kept in insect box. Date and place of collection were recorded. Temperature and relative humidity rates were adopted by Iraqi meteorological organization and seismology in Basrah Airport.

The study was made using a dissecting and compound microscopes. Species were identified based on morphological characteristics. Photographs of insects captured using

camera Nikon D90. Figures of some body insects have been improved with camera lucida and stereo microscope. The specimens were identified to the species level using the taxonomic keys of (1) and (16). Temperature and relative humidity rates were adopted by Iraqi meteorological organization and seismology in Basrah Airport. Percentages of abundance of stable flies were calculated each month during the study period. The rates of all months were compared. The results were statistically analyzed using chi-square. Some field observations, the daily activity of the stable flies, and the livestock attacking them were also recorded.

RESULTS

Morphological study:

Stomoxys calcitrans L.1758;Systema natura.

Stomoxys parasita Fabricius, 1781; 467 descr. NA.

Stomoxys nebulosa Fabricius, 1805;282 descr. - Americae meridionalinsulis.

Stomoxys sugillatrix Pobineau-Desvoidy, 1830: 386 descr. – Brazil.

General diagnosis:

Male length 4.4 to 6.4 mm. ,Female 3.6 to 6.5 mm. ,identical to male in color and structure except for wider frontal vitta, frontal triangle with golden pollinosity extending almost to frontal ridge, setae on head somewhat stouter than in male, Interocular space wide in females,and narrower in males around half the distance of separation in females. Frontal vitta in both sexes black pollinose, yellow around ocellar triangle, parafrontalia golden and parafacialia grayish black. Thorax gray to yellowish pollinose,pleura yellow; sternites dark brown to black, Legs black, base of tibia yellowish-brown, Wing tinged smoky-brown. Abdomen gray to yellowish; dorsum with four brownish pollinose spots, at least 3 abdominal segments with a single median spot basally and pair of spots at apex of each segment.

Head:

Length ahead 1-1.5 mm. .The **vertex** bears two pairs of large ocular setae, they are usually divergent(Figure1,2), outer and inner ocular pair. They are more or less located behind the upper and lower corner of the eyes. The upper ocular setae form a short,

well-developed row bordering the back part of the compound eyes. The oculars are usually proclinate or divergent, situated on the upper part of the parafront between the front and orbit. Compound eyes bare, very large, occupying most of head, strongly emarginated, 8 to 10 frontal setae, frons with several microsetae, ocellar bristles well-developed; and four minute interocellar pairs.

The **antenna** (figure2): the scape, or first segment, is the smallest, collarlike and slightly compressed laterally, There are two or more small to large setae on the anterior surface. The pedicel or second segment is longer, and there is a ring of setae on its anterior surface. The flagellum or third segment is the largest, and twice as long as pedicel. All three segments are covered with short, and fine pubescence. The arista is located dorsally on the flagellum, and has three segments, The first and two segments are short and cylindrical, The third segment is long, and slightly larger at the base and tapering from the basal third into a fine hairlike tip. The arista is plumose on the dorsal surface and bare on the ventral(plate1).

Proboscis is very long(2-3mm.), subshiny, homy, basein swollen, labella very small which are adapted to blood-sucking, palpus slender, small, not longer than antenna(Figure3). The labium that forms the piercing organ, the prementum is drawn out into a long, rigid shaft. The labellae, spreading lobes, are reduced to pair of small hard plates at the tips of the prementum, armed internal with eversible teeth. The prestomal teeth form the cutting organs. The labrum and the hypopharynx are contained within the gutter of the labium forming a strong piercing shaft.

Thorax:

Thorax length(1.5-2.5mm.).The thoracic segments covered with minute yellowish pilosity(Figure4). The first and last segments are greatly reduced,the mesothorax forming the greater part of the whole. The dorsum of the thorax, with the exception of the humeri, humeral callosities are the upper portions of the pronotum. Anterior to the base of the wings a suture crosses the mesonotum. This is the transverse suture which separates the anterior region or prescutum from a posterior region, the scutum. above the halteres, another suture crosses the mesonotum separating the scutum from posterior,slightly triangular region, the scutellum.The mesonotum bears two distinct rows of large, strong

dorsocentral setae which diverge slightly posteriorly. Each row consists of several setae which run from the prescutum to the scutum.

Wings: Length (3.5-4.5mm.), The costal vein extends to the tip of the fourth vein, and is weakly pectinate, tip of the auxiliary vein, the costal vein is broken and a short to long seta, which may be weak or stout, is located at the basal side of the break. At the base of the costal vein there are two scales, the humeral plates, which have been called the tegulae or epaulets. These lie over the base of the vein; the uppermost one has been called the tegula and the lower sub-tegula. Third wing vein setulose on node and beyond on both surfaces; and fourth vein distinctly curved forward but not strongly, ending slightly behind wing tip. Lower calypter rounded apically, but inner margin reaches almost to end of bare suprasquamal ridge (Figure 1). The calypters are two basal lobes of the posterior margin of the forewing between the wing base and the alula. The halteres are modified, drumstick-shaped hind wings located on each side of the metanotum. They consist of three parts: A thick base (the scabellum), a slender stemlike section (the pedicel) and a thick distal end (the capitellum).

Legs: The three pairs of legs are similar in structure, length legs 3.5-4.5 mm. (Figure 2). The general structure of the legs is similar to that of other calyptrate flies and requires no special consideration except for the nomenclature of the setal arrangement. Fore femur with rows of posterodorsal, posterior and posteroventral setae. Fore tibia with almost straight rows of very short setae, preapically with short, conspicuous anterodorsal, anterior and anteroventral setae. Fore tarsi in both without outstanding, long and anterior hairlike setae. Mid femur with short, thick anterior and anteroventral setae; long, thin basal ventral seta; several stout and thin apical posteroventral setae; mid tibia with one short apical anterior; anteroventral, one long ventral, one short posterior and one dorsal seta. Hind femur with row of stout setae running from anterodorsal to dorsal side, row of short setae on ventral side, one long seta near apex. Hind tibia with a mat of short thin setae, and several short rows of anterior setae thicker and slightly longer than the ventral, apically with a conspicuous dorsal seta.

Abdomen:

The abdomen is subcylindrical in shape,length 1.5-2.5mm. (Figuer^v). It consists of 10 segments divided into the preabdomen (the first 5 segments) and the postabdomen or hypopygium. When viewed dorsally the abdomen appears to be composed of four segments in the female and five in the male. However,there is an imperfect suture which separates the first and second tergites dorsally,and a plate which indicates the first segment as being distinct from the second ventrally. Abdominal setae long and thin, especially at apex of segments, sides, and all of segment 5. Abdominal sternites with a lateral row of long, thin setae. Tergum covered with strong, longer at sides, sternites covered with long, yellowish setae.

In male ninth sternite is called a hypandrium(Figure[^]),the ninth tergite is called a epandrium. On its hind margin the epandrium carries two pairs of small appendages,named parameres. The aedeagus can be divided in two distinct parts,two pairs of appendages are found at the sides of the aedeagus, named gonapophyses.The postabdomen in the female is reduced and slender(Figure[^]). The terminal abdominal segments in the female always form an ovipositor. The genital opening is situated between the eighth and ninth sterna. The tenth segment consists of a ventral plate and a dorsal plate, with a pair of cerci.



Figure1: Posterior view of stable fly *Stomoxys calcitrans* . 4X.



Figure2: Lateral view of *S. calcitrans* head. 10X.



Figure3: Proboscis of *S. calcitrans*. 10X.



Figure4: Posterior view of *S. calcitrans* thorax. 10X.

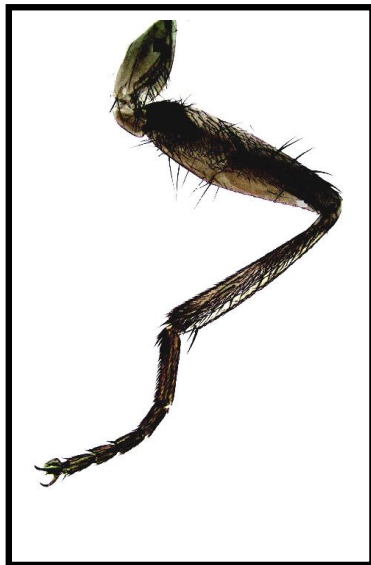


Figure5: leg of *S. calcitrans*. 10X



Figure6: Wing of *S. calcitrans*. 10X

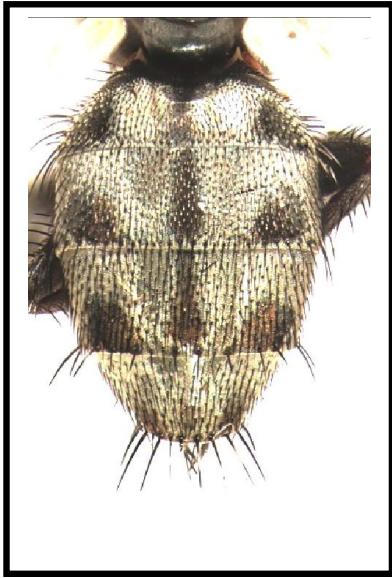


Figure7: Posterior view of *S. calcitrans* abdomen. 4X



Figure8: Male genitalia of *S. calcitrans*. 10X

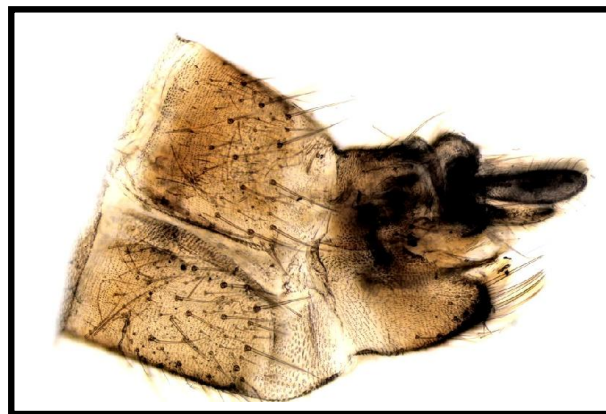


Figure9: Female genitalia of *S. calcitrans* . 10X

Ecological study:**Seasonal abundance :**

A total of 470 flies of *Stomoxys calcitrans* were collected in this study. The variations of abundance were determined monthly during one year between June 2016 to May 2017. For four different climatic seasons: cool, hot, moderate and rainy. In general, stable flies were found to be more abundant in the moderate climates period of the year (Figure 10). April was the highest with *S. calcitrans* abundance with 18.7%, while, compared with January and December. The results showed a significant differences ($P < 0.05$) among the prevalence of months.

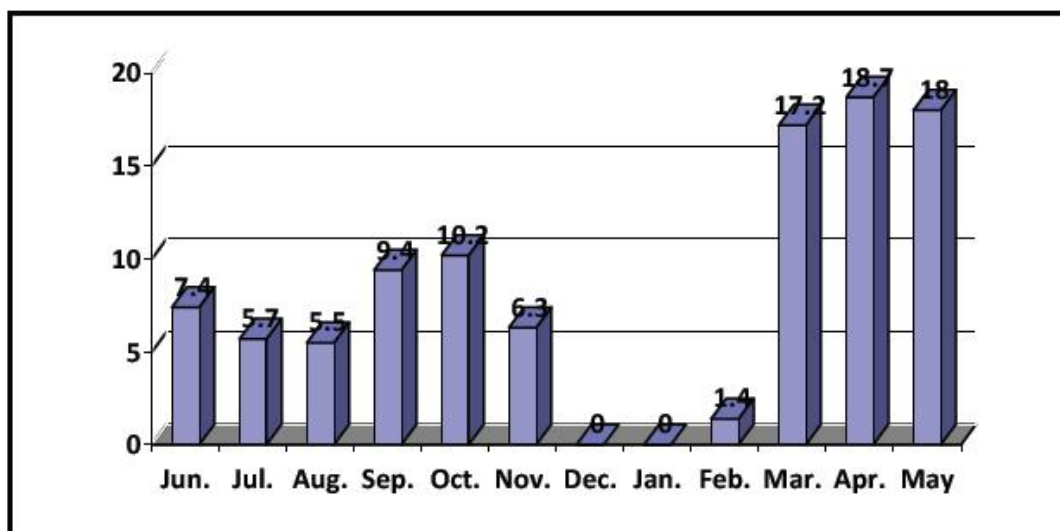


Figure10: Relative abundance of *Stomoxys calcitrans* in Basrah province during June 2016 to May 2017.

Daily activity:

The current study showed that Stable flies were found in the field in different periods of the day (Table1), starting at 06:00 to 18:00 hr. But there are periods that are considered the peak of its presence. In cool season, a peak of activity was observed from 9:00 to 14:00 hr. , In moderate season, a main peak of activity occurred in the 8:00 to 1:00 hr. , In summer periods the most activity was noted from 7:00 to 12:00 hr.. During

the rainy season, no activity was occurred all along the day. Both sexes of *S. calcitrans* show a same peak of activity in the day nearly, sometimes females showed a peak of activity more than males especially afternoon, even before or after sun set of the day.

Table 1: Peak of diurnal activity of *Stomoxys calcitrans* in Basrah province during June 2016 to May 2017.

Months	Temperature °	Relative humidity %	Peak of diurnal activity
June	40	19.7	7:00 – 11:00 hours
July	42	20	7:00 – 11:00
August	41	20	7:00 – 11:00
September	38	24.4	7:00 – 12:00
October	35	24.2	7:00 – 1:00
November	28	45.2	8:00 – 1:00
December	19	53.4	-
January	17	65.5	-
February	20	63.6	9:00 – 11:00
March	29	41.4	8:00 – 1:00
April	33	33.4	8:00 – 1:00
May	38	29.7	8:00 – 12:00

Hosts:

The field observations about stable flies behavior in their habits, showed that *Stomoxys calcitrans* adults attack many economic and domesticated animals in Basrah province. Cattle are the most preferred hosts for stable flies, followed by buffaloes, dogs, horses, cats, camels, donkeys than sheep, goats and rabbits. In the zoo in Shatt Al-Arab district, the stable flies were seen as attacking the lion, wolves, monkeys and foxes.

DISCUSSION

Few studies of taxonomy and morphology about Stomoxyine flies have been conducted in Middle east countries, especially Iraq, little study reviewed by (17) who expected one species of stable flies found in Iraq. The flies which belong to subfamily Muscinae can be separated from all other Muscidae by their long, slender, projecting and strongly chitinous proboscis(1), gradually slender from the base to apex, ordinarily without the apical thickened and setulose soft labella but fitted for piercing(5). The palps are usually shorter than the proboscis, the arista is bare in the superior part, and rarely with some hairs on the lower side(16). All the genera of tribe Stomoxysine have epimeron and prosternum partially covered with hairlike setulae(18). The chaetotaxy of the legs is of great importance at the specific and generic level throughout the tribe Stomoxysine(18). The system of setal arrangement was first proposed by (16), the exact position and row of a seta must be fairly accurately determined in accordance with the generally accepted terminology of (19).

The genus *Stomoxys* is distinguished from other Stomoxysines principally by the long proboscis, small palps, and the arista, which is pectinate on the upper part only(18). The markings, shape and number of sclerites and setae are quite distinct and can be used in species differentiation(15). *Stomoxys calcitrans* commonly known as the stable fly, the biting house fly or the dog fly, is differs about other species by short palps, not as long as sclerotized portion of proboscis, and stout, black katepisternal seta; meron with short hairlike setulae(17). *S. calcitrans*, is distinguished from all other common domestic flies by its piercing proboscis which protrudes bayonet like in front of the head(18). The shape, markings and setae on the male and female genitalia are used for species differentiation in many Stomoxysines(16).

For the study of seasonal abundance, the results showed statistically different numbers between months. The greatest number of stable flies was captured during the moderate season, especially in March, April, and May. There were few flies in the summer, such as July and August. while no presence was capture during the cool seasons. The high number of stomoxyine flies collected in is the consequence of

appropriate environmental conditions, temperature, moisture, light intensity and rainfall to maintain suitable breeding habitats(2). In the USA, a single seasonal peak of density for *S. calcitrans* was noted during the summer season, whereas marked bimodal and trimodal peaks have been documented in other locations(19). In Thailand, some observations showed that a peak of density of *S. calcitrans* was during the rainy season (20).

The summer and cool seasons showed lower numbers of flies; that could be explained by the rainfalls and high temperature, which are unsuitable conditions for larval development (1). It should have been useful to extend such a survey on a 12 month periods for a better explanation of the variations of fly density throughout the year.(21) reported that *S. calcitrans* had the highest activity when temperatures range from 30-35 °C.

The variations of diurnal activity have been found among different period of times (06:00 to 18:00) during the year. The patterns of activity between the most abundant species were quite different. The results confirm the crepuscular activity of *S. calcitrans* already indicated by (1), who recorded that those flies are more active in the morning, and in the evening they are readily collected by using light-traps set in cowsheds. (22) found the patterns during all seasons indicate a variation of diurnal activity, this pattern is unimodal in cool season (peak in the afternoon) and summer season (peak in the morning), but bimodal in rainy season.(23) reported that females *S. calcitrans*, a more or less constant activity was observed all along the day during all seasons more than males.

Many authors have worked on the activity of stomoxiine flies focused only on *S. calcitrans*,(24) observed unimodal feeding activity patterns on daily feeding in Uganda. (25) in Thailand reported that *S. calcitrans* showed the highest activity at sunset and dawn.(26) showed that *S. calcitrans* an activity all through the day with a peak between 08:00 am to 10:00 am. (21) found that the pattern of daily activity of *S. calcitrans* was affected by temperature, humidity and the level of solar radiation.

Cows are the most common hosts which stable flies attacks in the local environment in Basrah. The reason is that cows are the most common farm animals. However, (15)

mentioned the existence of links between the flies of the stables and their hosts, and (10) found that the stable flies attack larger mammals more than small.

دراسة تشخيصية لذبابة الاسطبل (*Stomoxys calcitrans* L. 1758 (Diptera:Muscidae)

في محافظة البصرة وملاحظة بعض الجوانب البيئية لها .

علاء ناظم حاتم

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الخلاصة

أجريت هذا الدراسة خلال الفترة من شهر حزيران عام ٢٠١٦ لغاية أيار عام ٢٠١٧ ، لتوضيح الصفات المظهرية لذبابة الاسطبل *Stomoxys calcitrans* ، وكذلك لمعرفة بعض الجوانب البيئية المهمة لها . علماً بأن هذه الدراسة تجرى للمرة الأولى في العراق. يمكن توضيح التشخيص العام لذبابة الاسطبل كالاتي : تغطي جبهة الرأس بزغب أسود ، ويكون أصفر اللون حول العيون البسيطة ، ذهبي في منطقة جار الجبهة ، ورساوي مسود على منطقة جار الخد . الصدر رساوي مصفر اللون ، والصفائح الجانبية صفراء بينما تكون الصفائح القصية بنية مسودة أو رمادية . الأرجل معظمها أسود اللون ، وعروق الأجنحة بنية مغبرة ، البطن رساوية مصفرة ، والصفائح الظهرية عليها أربعة بقع بنية فاتحة ، والحلقات الثلاثة الأخيرة تحمل بقعة وسطية وزوج من البقع الجانبية . يبلغ طول الذكر ٤.٥-٦.٥ ملم والانثى ٤-٦.٥ ملم . تشابه الأنثى الذكر باللون والشكل الخارجي تقريباً ولكنها تختلف عنه بوجود مساحة فاصلة أكبر بين العيون المركبة ، وكذلك المثلث الجبهي يكون ذهبي اللون ، وشعيرات الرأس أكثر تغلظاً ، وكذلك تكون المسافة الفاصلة بين العيون البسيطة في الاناث أعرض مما في الذكور .

جمعت ٤٧٠ عينة من ذباب الاسطبل خلال فترة الدراسة . لوحظ وجود تباين بين توزيع الذباب حسب أشهر فترة الدراسة وخلال فصول السنة الأربعة ، وبصورة عامة يتواجد ذباب الاسطبل بأعداد أكبر في البيئة خلال درجات الحرارة المعتدلة وكان شهر نيسان هو الأكثر تواجداً ونسبة ١٨.٧% ، بينما لم تجمع أي عينة خلال شهري كانون الأول وكانون الثاني . وسجلت كذلك بعض الملاحظات الحقلية عن ذباب الاسطبل ومنها تواجده في معظم فترات النهار ومن الساعة السادسة صباحاً وحتى السادسة مساءً ، ولكن توجد له فترة لذروة الانتشار تختلف من حيث أشهر السنة ولكنها تبدو متشابهة تقريباً بين الذكور والاناث . يهاجم ذباب الاسطبل عدداً من الحيوانات الاقتصادية والمنزلية في محافظة البصرة ، وتعد الأبقار هي الأكثر يليها الجاموس والكلاب والخيول والقطط والجمال والحمير ، وبصورة أقل الأغنام والماعز والأرانب .

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